# Types and intensities of vegetation **f**ires and their impact on **la**kes' ecosyste**m**s across **E**uropean tran**s**ect (**FLAMES**)

Earth is the only known planet where fire can occur naturally - everywhere else there is not enough oxygen for this process to occur. Since fire appeared on Earth many millions of years ago, it has played a key role in the development of plant adaptation as well as the distribution of ecosystems. Unfortunately, since humans started using fire for their own needs, they have greatly influenced the change of the fire regime, often in a way that has affected the sustainability of some ecosystems.

It is known that fires in various regions of the world are triggered by prevailing weather conditions, human activity or a combination of these factors, but the answer to what extent this occurs is still little known. This applies especially to those areas which, due to the predominant climate and type of vegetation, are considered to be not endangered by fire. However, the changing climate and the related increase of global temperature and the number of extreme drought events show that today fire is existing and still growing threat also for central and northern Europe.

Lakes are considered as one of the best natural archives to track environmental and climatic changes because they store information available not only from their direct catchment but also from a bigger area. Lake sediments are well-known for capturing and preserving charcoal both from the local watershed and regional area. Unfortunately, they are subjected to strong influences that can lead to many negative effects. One of the most dangerous threats to the aquatic environment is eutrophication. Under natural conditions, a change in the trophic state of a lake may take several hundred years, but human activity significantly accelerates the natural process, causing, among others, deterioration of water quality, change of species composition reducing biodiversity, oxygen depletion and, in the worst-case scenario, ecosystem death. It is suspected that fires may have a similar, negative effect on the aquatic environment by increasing the nutrient supply due to the depletion of local soils in phosphorus and nitrogen, which are crucial for primary productivity in aquatic systems. However, this phenomenon is merely unexplored. Therefore, lakes are essential knowledge sources of past changes and offer an excellent opportunity to study an interplay between fire behavior and limnological processes as well as fire events effects on the lacustrine ecosystem as a whole.

Linking fire intensity to changes in primary lake productivity will improve the understanding of the complex interactions between a fire regime and the functioning of the lake ecosystem. FLAMES project will focus on four different regions of Europe, making it possible to track fire behavior and its effects on lake ecosystems across latitudes via a NE-SW transect. A set of novel methods will be used, including reflectance measurements of charcoals found in lake sediments, as well as hyperspectral imaging, the combination of which will allow us to reliably reconstruct fire intensity and changes in the lake's primary productivity in the past. Additionally, a set of analyzes will be performed to determine the condition of the ecosystem before (baseline conditions) and after increased human activity. This will include reconstruction of the vegetation cover in the studies areas and insights into geochemical changes in lakes through time.

FLAMES will answer the following questions i) how coupled climate and anthropogenic interactions have influenced fire behavior?, ii) what were the effects of fire episodes on limnological processes, nutrient cycles and coupled ecosystem feedbacks?, and iii) how these processes have affected ecosystem resilience and ecosystem services?